Document Object Model (DOM)
A brief introduction

Overview of DOM

Document Object Model (DOM) is a collection of platform-independent abstract data types (interfaces) for access and manipulation of documents.

There exist several levels of DOM, which identify interfaces for various specific functionality. At each level, there is a *core* specification, providing basic functionality and extensions, providing extra interfaces for specific tasts/document types. For example DOM **Level 1** specification includes DOM for HTML. A short overview of the DOM levels follows.

DOM Level 0. Historically, DOM was developed as a response to the need to standardize the internal HTML document model for world wide web browsers. As such **Level 0** funcitonality summarizes legacy interfaces, which predated the establishment of DOM. In DOM **Level 0**, a document is represented as a collection of lists (tables, arrays) of various components that it is formed of (e.g., for HTML documents: anchor tags, images, etc).

DOM Level 1. Documents are represented as tree structures (DOM Trees). Different types of nodes are defined, and DOM Tree traversal APIs are given for each type. The APIs are *atomic* - traversal is performed one edge at a time, but powerful - any algorithm for working with trees can be built on top of these APIs.

DOM Level 2. Extends DOM **Level 1** with support for *namespaces*[1] It also extends DOM core with new APIs for views, events and stylesheet support.

DOM Level 3. Further extension of DOM **Level 2** with refined namespace support, as well as support for loading and saving documents and for their validation.

[1] Namespaces is a rather broad concept. In a nutshell, a namespace is a way to bind an XML element to a specific markup spec, and allow for the use of XML elements from different markup specs to encode information... In reality, things are more complicated.

DOM Level 1 (Core)

We will concentrate on functionality provided in DOM **Level 1**. DOM is a W3C standard. W3C activity related to DOM is documented at

http://www.w3.org/DOM/

The DOM **Level 1** recommendation can be found at

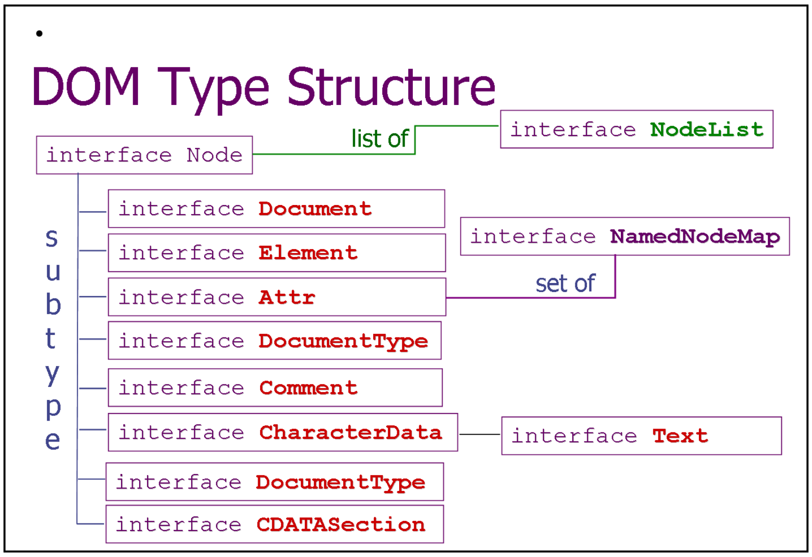
http://www.w3.org/TR/1998/REC-DOM-Level-1-19981001/

(note: this is a pointer to the W3C recommendation. There is a working draft of second edition of this document as well.).

DOM **Level 1** (core) consists of a number of interfaces (ADTs) designed to represent an entire XML document, its individual components, and collections of these components. This handout provides a brief overview of these interfaces. Some information is omitted for clarity, refer to the original Recommendation for the full spec.

DOM Level 1 (Core) Interface structure

The structure of the main part of DOM **Level 1** is shown on the diagram below.



DOM **Level 1** defines one interface, `interface Node` to represent any component of the document. This interface is further refined to create special-purpose interfaces of the following types:

`interface Document:`	representation of the entire document
`interface Element:`	XML element nodes
`interface Attr:`	XML attribute nodes
`interface DocumentType:`	DTD nodes
`interface Comment:`	comments
`interface CharacterData:`	any parsed character data in the document
`interface Text : CharacterData:`	text nodes
`interface CDATASection:`	nodes for CDATA sections

Each interface contains a list of fields (attributes) and a list of methods. Brief overview of each interface is provided below.

General Notes

DOM **Level 1** assumes the following abstraction of an XML document. The entire document is accessed via the `Document` interface. DOM implementations must create class `Document` to represent XML documents.

From the `Document` object, access is granted to its components. The components and their nesting are determined according to the XML recommendation. E.g., the `Document` object can contain several `Comment` objects, but only one `Element` object.

All these abstract types are subtypes of a single type `Node` which provides basic access and traversal functionality. Individual subtypes tailor the API functionality to suit their roles.

Interface Node

The formal definition of this interface is reproduced from the Recommendation:

```
interface Node {

  readonly attribute  DOMString           nodeName;
           attribute  DOMString           nodeValue;
  readonly attribute  unsigned short      nodeType;
  readonly attribute  Node                parentNode;
  readonly attribute  NodeList            childNodes;
  readonly attribute  Node                firstChild;
  readonly attribute  Node                lastChild;
  readonly attribute  Node                previousSibling;
  readonly attribute  Node                nextSibling;
  readonly attribute  NamedNodeMap        attributes;
  readonly attribute  Document            ownerDocument;


  Node                      insertBefore(in Node newChild,
                                         in Node refChild)
                                         raises(DOMException);
  Node                      replaceChild(in Node newChild,
                                         in Node oldChild)
                                         raises(DOMException);
  Node                      removeChild(in Node oldChild)
                                        raises(DOMException);
  Node                      appendChild(in Node newChild)
                                        raises(DOMException);
  boolean                   hasChildNodes();
  Node                      cloneNode(in boolean deep);
};
```

The brief explanation of the fields defined in this interface is below:

Type	Attribute	Explanation
DOMString	`nodeName`	name of the node
DOMString	`nodeValue`	the value of the node (see below)
unsigned short	`nodeType`	type of the node (see table below)
Node	`parentNode`	parent of the node in the DOM tree
NodeList	`childNodes`	List of all child nodes of the node in the DOM tree
Node	`firstChild`	first child of the node in the DOM tree
Node	`lastChild`	last child of the node in the DOM tree
Node	`previousSibling`	previous sibling of the node in the DOM tree
Node	`nextSibling`	next sibling of the node in the DOM tree
NamedNodeMap	`attributes`	Attributes of the node
Document	`ownerDocument`	document object to which this node belongs

Here are the methods:

Return Type	Method	Explanation
Node	`insertBefore(newChild, refChild)`	inserts `newChild` before the `refChild`
Node	`replaceChild(newChild, oldChild)`	replaces `oldChild` with `newChild`
Node	`removeChild(in Node oldChild)`	removes `oldChild` from the list of children nodes
Node	`appendChild(in Node newChild)`	adds `newChild` as the last child of the node
boolean	`hasChildNodes()`	checks if the node has children in the DOM tree
Node	`cloneNode(in boolean deep)`	creates a deep copy of the node

The `nodeType` attribute of the `Node` object contains information about the type of the attribute. The types are defined as follows.

Node type constant	Value	Node type
`ELEMENT_NODE`	1	XML Element
`ATTRIBUTE_NODE`	2	XML Attribute
`TEXT_NODE`	3	Text (leaf node)
`CDATA_SECTION_NODE`	4	CDATA Section
`ENTITY_REFERENCE_NODE`	5	Entity Reference
`ENTITY_NODE`	6	Entity
`PROCESSING_INSTRUCTION_NODE`	7	Processing instruction
`COMMENT_NODE`	8	Comment
`DOCUMENT_NODE`	9	Entire XML document
`DOCUMENT_TYPE_NODE`	10	DTD description
`DOCUMENT_FRAGMENT_NODE`	11	document fragment
`NOTATION_NODE`	12	notation

Depending on the *type* of the node, `nodeName`, `nodeValue` and `attributes` acquire different purposes. The following table sunmarizes the possible combinations.

`nodeType`	type of node	`nodeName`	`nodeValue`	`attributes`
1	Element	tag name	*null*	NamedNodeMap
2	Attr	name of attribute	value of attribute	*null*
3	Text	`"#text"`	content	*null*
4	CDATASection	`"#cdata-section"`	content	*null*
5	EntityReference	name of entity referenced	*null*	*null*
6	Entity	entity name	*null*	*null*
7	ProcessingInstruction	target	content – target	*null*
8	Comment	`"#comment"`	content	*null*
9	Document	`"#document"`	*null*	*null*
10	DocumentType	document type name	*null*	*null*
11	DocumentFragment	`"#document-fragment"`	*null*	*null*
12	Notation	notation name	*null*	*null*

Interface Document

The `Document` interface allows access to XML documents as whole objects.

```
interface Document : Node {
  readonly attribute  DocumentType         doctype;
  readonly attribute  DOMImplementation    implementation;
  readonly attribute  Element              documentElement;
  Element                   createElement(in DOMString tagName)
                                          raises(DOMException);
  DocumentFragment          createDocumentFragment();
  Text                      createTextNode(in DOMString data);
  Comment                   createComment(in DOMString data);
  CDATASection              createCDATASection(in DOMString data)
                                               raises(DOMException);
  ProcessingInstruction     createProcessingInstruction(in DOMString
target,
                                                        in DOMString data)

raises(DOMException);
  Attr                      createAttribute(in DOMString name)
                                            raises(DOMException);
  EntityReference           createEntityReference(in DOMString name)
                                                  raises(DOMException);
  NodeList                  getElementsByTagName(in DOMString tagname);
};
```

Interface Element

Each XML element is mapped to an instance of an `Element` object. The definition is:

```
interface Element : Node {
  readonly attribute  DOMString            tagName;
  DOMString                 getAttribute(in DOMString name);
  void                      setAttribute(in DOMString name,
                                         in DOMString value)
                                         raises(DOMException);
  void                      removeAttribute(in DOMString name)
                                            raises(DOMException);
  Attr                      getAttributeNode(in DOMString name);
  Attr                      setAttributeNode(in Attr newAttr)
                                             raises(DOMException);
  Attr                      removeAttributeNode(in Attr oldAttr)
                                                raises(DOMException);
  NodeList                  getElementsByTagName(in DOMString name);
  void                      normalize();
};
```

Interface Attr

Individual XML attributes are accessed via the `Attr` interface.

```
interface Attr : Node {
  readonly attribute  DOMString            name;
  readonly attribute  boolean              specified;
```

```
          attribute  DOMString            value;
};
```

Fields:

Type	Field Name	Explanation
DOMString	`name`	name of the attribute
boolean	specified	`true` if attrbute is explicitly defined in the document
DOMString	`value`	value of the attribute

The `Attr` interface provides only the three fields that store infromation about a single attribute. Because attributes are access from `Element` objects via the `NamedNodeMap` interface, main access/creation methods to attributes in the `Elmenent` and `NamedNodeMap` interfaces.

interface CharacterData

This is the base interface for character type nodes. The definition is:

```
interface CharacterData : Node {
          attribute  DOMString            data;
  readonly attribute  unsigned long        length;

  DOMString                substringData(in unsigned long offset,
                                         in unsigned long count)
                                         raises(DOMException);
  void                     appendData(in DOMString arg)
                                      raises(DOMException);
  void                     insertData(in unsigned long offset,
                                      in DOMString arg)
                                      raises(DOMException);
  void                     deleteData(in unsigned long offset,
                                      in unsigned long count)
                                      raises(DOMException);
  void                     replaceData(in unsigned long offset,
                                       in unsigned long count,
                                       in DOMString arg)
                                       raises(DOMException);
};
```

This interface provides access to direct string manipulation methods.

Interface Comment. Interface `Comment` inherits all its properties from interface `CharacterData`.

Interface Text

Interface `Text` represents leaf nodes of the XML document (DOM tree), which contain only #PCDATA in them. This interface extends `CharacterData` with a single method `splitText()` for breaking off portions of the content of the text node into a new text node.

```
interface Text : CharacterData {
  Text                     splitText(in unsigned long offset)
};
```

Interface CDATASection. Interface `CDATASection` inherits *all* its properties from `Text`. This interface represents CDATA (unparsed character data) sections in the XML document. (typical XML documents generated for data managment tasks rarely contian CDATA sections).

```
interface CDATASection : Text {
};
```

Interface DocumentType

This interface provides access to the actual DTD content.

```
interface DocumentType : Node {
  readonly attribute  DOMString           name;
  readonly attribute  NamedNodeMap        entities;
  readonly attribute  NamedNodeMap        notations;
};
```

DOMString	`name`	name of the DTD
NamedNodeMap	`entities`	collection of all defined entities
NamedNodeMap	`notations`	collection of all defined notations

Interfaces NodeList and NamedNodeMap

Two more interfaces are defined *outside* the `Node` hierarchy, by closely connected with the `Node` interface.

`NodeList` interface defines the functionality for accessing an *ordered list* of `Node` objects. For each node, all its children are kept in order of their occurrence in the XML document, and thus, form a node list.

`NamedNodeMap` interface defines the functionality for accessing an *unordered collection* of `Node` objects. Since XML does not order attributes within a specific tag, a list of all attrbiutes for a given XML element is a `NamedNodeMap` instance.

Interface NodeList

```
interface NodeList {
  Node                                 item(in unsigned long index);
  readonly attribute  unsigned long   length;
};
```

`item(index)` returns the `Node` object which resides at position `index` in the list.

`length` is the total number of nodes in the list.

Interface NamedNodeMap

```
interface NamedNodeMap {
  Node                       getNamedItem(in DOMString name);
  Node                       setNamedItem(in Node arg)
  Node                       removeNamedItem(in DOMString name)
  Node                       item(in unsigned long index);

  readonly attribute  unsigned long        length;
};
```

`length` is the total number of elements in the collection.

`getNamesItem()` and `setNamedItem()` `removeNamedItem()` encapsulate access to the "named item" (i.e., a `Node` that has a name) by name.

`item(name)` retrieves the actual `Node` object by name.